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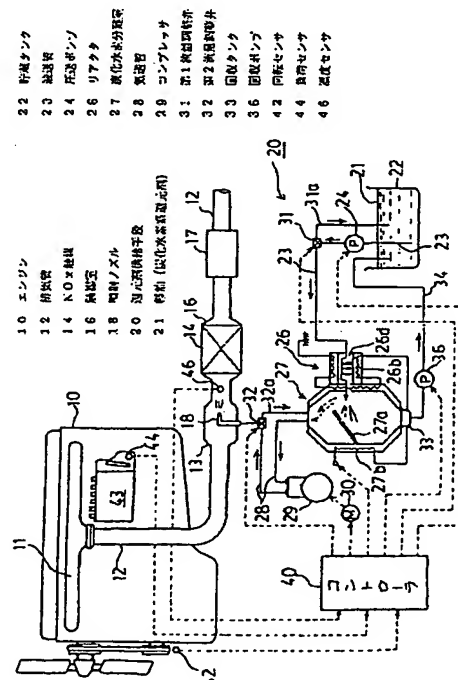
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(54)【発明の名称】 エンジン排ガスの触媒によるNO_x低減装置

(57)【要約】

【目的】 成分組成の点でNO_xのN₂への転化率が低い炭化水素系還元剤であってもこれを改質して効率良くNO_xを低減する。またエンジンの運転状態に応じて適量の還元剤を供給する。

【構成】 エンジン10の排気管12にNO_x触媒14とその排ガス上流側に噴射ノズル18が設けられる。この噴射ノズル18に炭化水素系還元剤を供給する還元剤供給手段20は、液状の炭化水素21を貯える貯蔵タンク22と、このタンク22に貯えられた炭化水素21を液送管23を介して圧送する圧送ポンプ24と、この圧送された炭化水素21をその炭素数を減少するように改質するリアクタ26と、改質された炭化水素と改質されなかった炭化水素とを分離する炭化水素分離室27と、改質された炭化水素を気送管28を介して噴射ノズル18に圧送するコンプレッサ29とを備える。



【特許請求の範囲】

【請求項1】 エンジン(10)の排気管(12)に設けられNO_x触媒(14)を収容する触媒室(16)と、前記NO_x触媒(14)の排ガス上流側に設けられ前記NO_x触媒(14)に向けて炭化水素系還元剤を噴射可能な噴射ノズル(18)と、前記噴射ノズル(18)に前記還元剤を供給する還元剤供給手段(20)とを備えたエンジン排ガスの触媒によるNO_x低減装置において、前記還元剤供給手段(20)が液状の炭化水素(21)を貯える貯蔵タンク(22)と、前記貯蔵タンク(22)に貯えられた炭化水素(21)を液送管(23)を介して圧送する圧送ポンプ(24)と、前記圧送された炭化水素(21)をその炭素数を減少するように改質するリアクタ(26)と、前記改質された炭化水素と改質されなかった炭化水素とを分離する炭化水素分離室(27)と、前記改質された炭化水素を気送管(28)を介して前記噴射ノズル(18)に圧送するコンプレッサ(29)とを備えたことを特徴とするエンジン排ガスの触媒によるNO_x低減装置。

【請求項2】 NO_x触媒(14)の排ガス上流側に設けられた温度センサ(46)と、エンジン(10)の負荷を検出する負荷センサ(44)と、エンジン(10)の回転速度を検出する回転センサ(42)と、液送管(23)に設けられた第1流量調整弁(31)と、気送管(28)に設けられた第2流量調整弁(32)と、前記温度センサ(46)、負荷センサ(44)及び回転センサ(42)の検出出力に基づいて圧送ポンプ(24)、コンプレッサ(29)、前記第1及び第2流量調整弁(31、32)を制御するコントローラ(40)とを備えた請求項1記載のエンジン排ガスの触媒によるNO_x低減装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】 本発明は、エンジンの排ガスに含まれる窒素酸化物（以下、NO_xという）を触媒により低減する装置に関する。更に詳しくは車両用エンジンの排ガス中のNO_x低減装置に関するものである。

【0002】

【従来の技術】 この種のNO_x低減装置として、エンジンの排気管にNO_x触媒を収容する触媒室を設け、このNO_x触媒の排ガス上流側より噴射ノズルでNO_xの還元剤を噴射して、触媒によりNO_xを無害なN₂に転化する装置が知られている。従来、この還元剤にはアンモニアが用いられてきた。

【0003】

【発明が解決しようとする課題】 しかし、アンモニアは車載性に劣り、かつ漏洩したときの臭気の問題から車両用エンジンのNO_x還元剤には不向きであった。また還元剤として軽油を用いた場合には、軽油は炭素数が16

の炭化水素成分を多く含み、この点で効率良くNO_xをN₂に転化することができず、そのまま大気に放出されてしまうNO_xの割合が高い不具合があった。本発明の目的は、成分組成の点でNO_xのN₂への転化率が低い炭化水素系還元剤であってもこれを改質して効率良くNO_xを低減し得る、エンジン排ガスの触媒によるNO_x低減装置を提供することにある。本発明の別の目的は、エンジンの運転状態に応じて適量の還元剤を供給し得るNO_x低減装置を提供することにある。

【0004】

【課題を解決するための手段】 上記目的を達成するための本発明の構成を実施例に対応する図1に基づいて説明する。本発明は、エンジン10の排気管12に設けられNO_x触媒14を収容する触媒室16と、NO_x触媒14の排ガス上流側に設けられこのNO_x触媒14に向けて炭化水素系還元剤を噴射可能な噴射ノズル18と、噴射ノズル18に前記還元剤を供給する還元剤供給手段20とを備えたエンジン排ガスの触媒によるNO_x低減装置の改良である。その特徴ある構成は、還元剤供給手段20が液状の炭化水素21を貯える貯蔵タンク22と、このタンク22に貯えられた炭化水素21を液送管23を介して圧送する圧送ポンプ24と、この圧送された炭化水素21をその炭素数を減少するように改質するリアクタ26と、改質された炭化水素と改質されなかった炭化水素とを分離する炭化水素分離室27と、改質された炭化水素を気送管28を介して噴射ノズル18に圧送するコンプレッサ29とを備えたことにある。なお、このNO_x低減装置に、NO_x触媒14の排ガス上流側に設けられた温度センサ46と、エンジン10の負荷を検出する負荷センサ44と、エンジン10の回転速度を検出する回転センサ42と、液送管23に設けられた第1流量調整弁31と、気送管28に設けられた第2流量調整弁32と、温度センサ46、負荷センサ44及び回転センサ42の検出出力に基づいて圧送ポンプ24、コンプレッサ29、第1及び第2流量調整弁31、32を制御するコントローラ40とを備えることが好ましい。更に、このNO_x低減装置の炭化水素分離室27の底部に改質されなかった液状の炭化水素を回収する回収タンク33を設け、この回収タンク33の液状の炭化水素を貯蔵タンク22に戻す回収ポンプ36を設けることが好ましい。

【0005】

【作用】 エンジン10から排出されたガスは排気管12を通り、噴射ノズル18から供給された還元剤とともに触媒室16に流入し、そこで排ガス中のNO_xはNO_x触媒14により還元処理されて無害のN₂に転化した後、大気に放出される。噴射ノズル18から供給される還元剤は、質的にはリアクタ26でクラッキングされ、分離室27で精製分離された炭素数の減少した低分子量の炭化水素であるため、高い効率でNO_xをN₂に転化

する。また量的にはコントローラ40が運転状態に応じて記憶される排ガス中のNO_x含有量に見合った適量の還元剤を流量調整弁31、32等を制御して噴射ノズル18から供給する。

【0006】

【実施例】次に本発明の一実施例を図面に基づいて詳しく説明する。図1に示すように、ディーゼルエンジン10の排気マニホールド11には排気管12が接続される。この排気管12の途中にはエンジン側から還元剤噴射室13と、NO_x触媒14を収容する触媒室16と、マフラー17がこの順に設けられる。この例では、NO_x触媒14は銅イオン交換ゼオライト(Cu-ZSM-5)により構成される。この銅イオン交換ゼオライトはゼオライトが含んでいるナトリウムイオンを銅イオンに置き換えた物質であって、NO_xを炭化水素により還元する性質を有する。還元剤噴射室13には噴射ノズル18がNO_x触媒14に向けて設けられる。

【0007】噴射ノズル18に炭化水素系還元剤を供給する還元剤供給手段20は、軽油21を貯える貯蔵タンク22と、この軽油21を液送管23を介して圧送する圧送ポンプ24と、圧送された軽油の炭素数を減少するように改質するリアクタ26と、改質された炭化水素と改質されなかった炭化水素とを分離する炭化水素分離室27と、改質された炭化水素を気送管28を介して噴射ノズル18に圧送するコンプレッサ29とにより構成される。この例では、コンプレッサ29はモータ30により駆動される。ポンプ24の吐出側の液送管23には第1流量調整弁31が、またコンプレッサ29の吐出側の気送管28には第2流量調整弁32がそれぞれ設けられる。これらの調整弁31及び32は電磁弁であって、調整弁31及び32にはタンク22への戻り管31a及び炭化水素分離室27への戻り管32aがそれぞれ接続される。

【0008】リアクタ26はポンプ24から圧送された炭素数16の炭化水素を主成分とする軽油をクラッキングして主として炭素数3~10の成分に改質する。この例では、リアクタ26は粒状のゼオライトが充填されたカラム26aと、このカラム26aを加熱するヒータ26bとを備える。炭化水素分離室27は炭素数3~10に改質された軽油とそれ以外の軽油とに分離するセパレータ27aと、周囲にヒータ27bとを備える。カラム26aの入口は前記液送管23に接続され、その出口は炭化水素分離室27のセパレータ27aに向けられる。この分離室27の底部には改質されなかった液状の炭化水素を回収する回収タンク33が設けられ、分離室27の頂部には改質され気化した炭化水素を吸引する前述した気送管28と戻り管32aが接続される。この回収タンク33と貯蔵タンク22の間には回収管34が接続され、回収管34の途中には回収ポンプ36が設けられる。

【0009】第1及び第2流量調整弁31及び32、圧送ポンプ24、コンプレッサ駆動用モータ30、ヒータ26a及び27b、及び回収ポンプ36にはコントローラ40の制御出力が接続される。このコントローラ40の制御入力にはエンジン10の回転速度を検出する回転センサ42と、エンジンの負荷を検出する噴射ポンプ43のロードレバー位置センサ44と、触媒室16のNO_x触媒14に流入する排気温度を検出する温度センサ46とが接続される。コントローラ40は図示しないメモリを備える。このメモリにはエンジンの回転速度、負荷及び排気温度に応じて噴射ノズル18からNO_x触媒14に供給すべき炭化水素の量が予め記憶され、コントローラ40はこの供給量に基づいて調整弁31及び32、圧送ポンプ24、コンプレッサ駆動用モータ30等を制御する。

【0010】このような構成のNO_x低減装置の動作を説明する。まず、エンジン10から排出されたガスは排気管12を通り、還元剤噴射室13に入り、ここで噴射ノズル18により炭化水素系還元剤の供給を受ける。この還元剤の供給を受けた排ガスは触媒室16に入り、NO_x触媒14で排ガス中のNO_xを還元処理して無害のN₂に転化した後、大気に放出される。ここで噴射ノズル18から噴射される還元剤は次の方法によりその品質が改良される。まず、軽油が貯蔵タンク22から圧送ポンプ24によりリアクタ26のカラム26aに送られ、400~500℃の温度でゼオライト触媒に接触して分解し、気化する。この軽油のクラッキングにより軽油が主として炭素数3~10の低分子量の炭化水素に改質される。リアクタ26で改質されなかった高分子量の炭化水素は炭化水素分離室27のセパレータ27aで改質された炭化水素と分離される。この精製分離された改質還元剤はコンプレッサ29で圧縮され噴射ノズル18から噴射される。この炭素数の減少した炭化水素系還元剤は、NO_x触媒14において、NO_xをN₂に高い効率で転化する。

【0011】また噴射ノズル18から噴射される還元剤の量は次の方法により制御される。コントローラ40がセンサ42、44、46の検出力により運転状態に応じてメモリに記憶される排ガス中のNO_x含有量に見合った適量の還元剤を読み出し、この還元剤の量に応じて流量調整弁31、32、圧送ポンプ24、コンプレッサ駆動用モータ30等を制御して適量の還元剤を噴射ノズル18から供給する。具体的には、コントローラ40はエンジン10が低速回転域で軽負荷のときには噴射量を絞り、中高速回転域で中高負荷のときには噴射量を増大するように制御する。更に炭化水素分離室27で改質されなかった高沸点の炭化水素系還元剤は回収タンク33に回収され、回収ポンプ36により貯蔵タンク22に戻される。なお、上記例ではNO_x触媒として銅イオン交換ゼオライトを挙げたが、他のゼオライト系、酸化物系の

触媒でもよい。また、リアクタにおいて軽油をゼオライト触媒を用いて接触分解する例を示したが、酸化チタン、シリカーアルミナ触媒等他の触媒を用いてもよい。

【0012】

【発明の効果】以上述べたように、本発明によれば、炭化水素系還元剤が成分組成の点で NO_x の N_2 への転化率が低い高沸点の炭化水素を含む軽油等であっても、リアクタで改質し、炭化水素分離室で精製分離して、有効な炭化水素系還元剤を選択的に取出し噴射ノズルから噴射するため、 NO_x 触媒上で排ガス中の NO_x が効率良く N_2 に転化する。また、エンジンの運転状態に応じて還元剤の噴射量が制御され、結果として排ガス中の NO_x に応じて適量の還元剤を供給されるため、排ガスに含まれる NO_x を有効に低減することができる。

【図面の簡単な説明】

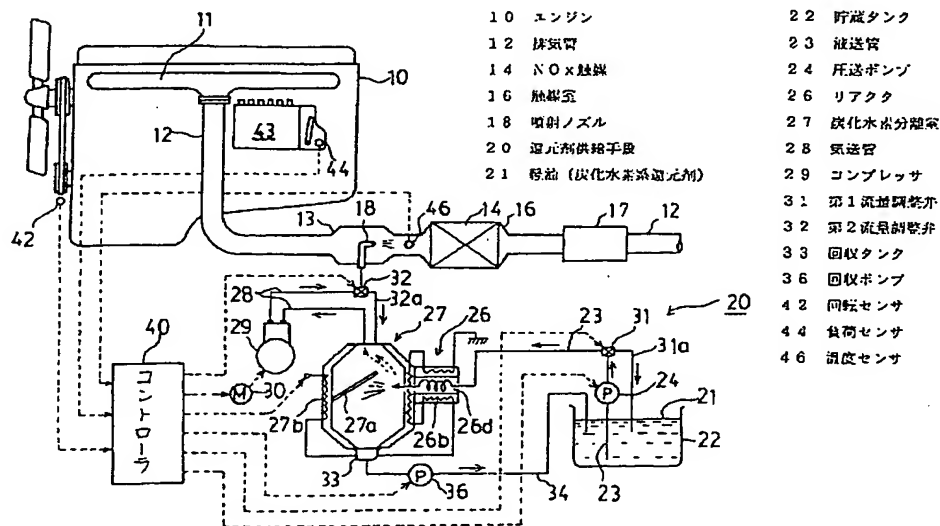
【図1】本発明の一実施例の NO_x 低減装置の構成図。

【符号の説明】

10 エンジン
12 排気管
13 還元剤噴射室

14 NO_x 触媒
16 触媒室
18 噴射ノズル
20 還元剤供給手段
21 軽油（炭化水素系還元剤）
22 貯蔵タンク
23 液送管
24 圧送ポンプ
26 リアクタ
27 炭化水素分離室
28 気送管
29 コンプレッサ
31 第1流量調整弁
32 第2流量調整弁
33 回収タンク
36 回収ポンプ
40 コントローラ
42 回転センサ
44 負荷センサ
46 温度センサ

【図1】



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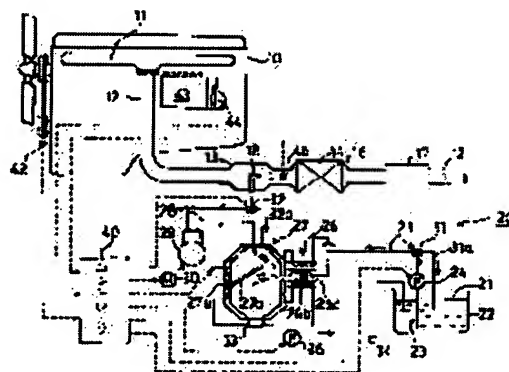
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UEMITSU ISAO
OTANI TETSUYA

(54) NOX-IN-ENGINE-EXHAUST-GAS REDUCING DEVICE BY MEANS OF CATALYST

(57)Abstract:

PURPOSE: To supply a proper quantity of reducing agents in accordance the operating condition of an engine, even if a hydrocarbon reducing agent having a low invert ratio of NO_x to N₂ in respect of component constitution is used, by reforming it so as to efficiently reduce NO_x.

CONSTITUTION: The exhaust pipe 12 of an engine 10 is provided with a NO_x catalyst 14 and an injection nozzle 18 arranged upstream thereof. A reducing agent supply means 20 for supplying a hydrocarbon reducing agent to the injection nozzle 18 is provided with a storage tank 22 for storing liquid hydrocarbon 21, a force-feeding pump 24 for forcibly feeding the hydrocarbon 21 stored in this tank 22 through a liquid feeding pipe 23, a reactor 26 for reforming the forcibly fed hydrocarbon 21 so as to reduce the number of carbons thereof, a hydrocarbon separating chamber 27 for separating the reformed hydrocarbon from the unreformed hydrocarbon, and a compressor 29 for forcibly feeding the reformed hydrocarbon to the injection nozzle 18 through a pneumatic tube 28.



LEGAL STATUS

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[Date of requesting appeal against examiner's decision of rejection]
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CLAIMS

[Claim(s)]

[Claim 1] The catalyst room in which it is prepared in the exhaust pipe (12) of an engine (10), and a NOx catalyst (14) is held (16) A reducing-agent supply means to be prepared in the exhaust gas upstream of the aforementioned NOx catalyst (14), and to supply the aforementioned reducing agent to the injection nozzle (18) which can inject a hydrocarbon system reducing agent, and the aforementioned injection nozzle (18) towards the aforementioned NOx catalyst (14) (20) The storage tank in which it is NOx reduction equipment by the catalyst of engine exhaust gas equipped with the above, and the aforementioned reducing-agent supply means (20) stores a liquefied hydrocarbon (21) (22), The feeding pump which feeds the hydrocarbon (21) stored in the aforementioned storage tank (22) through a liquid transfer pipe (23) (24), The reactor which reforms the hydrocarbon (21) by which feeding was carried out [aforementioned] so that the carbon number may be decreased (26), It is characterized by having the hydrocarbon separation room (27) which separates the hydrocarbon by which reforming was carried out [aforementioned], and the hydrocarbon which was not reformed, and the compressor (29) which feeds the hydrocarbon by which reforming was carried out [aforementioned] to the aforementioned injection nozzle (18) through the pneumatic tube (28).

[Claim 2] NOx reduction equipment by the catalyst of engine exhaust gas according to claim 1 characterized by providing the following. The temperature sensor prepared in the exhaust gas upstream of a NOx catalyst (14) (46) The load sensor which detects the load of an engine (10) (44) The rotation sensor which detects the rotational speed of an engine (10) (42) The 1st flow control valve (31) prepared in the liquid transfer pipe (23), the 2nd flow control valve (32) prepared in the pneumatic tube (28), and the controller which controls a feeding pump (24), a compressor (29), the above 1st, and the 2nd flow control valve (31 32) based on the detection output of the aforementioned temperature sensor (46), a load sensor (44), and a rotation sensor (42) (40)

[Translation done.]

* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] this invention relates to the equipment which reduces the nitrogen oxide (henceforth NOx) contained in the exhaust gas of an engine according to a catalyst. Furthermore, it is related with the NOx reduction equipment in the exhaust gas of the engine for vehicles in detail.

[0002]

[Description of the Prior Art] As this kind of NOx reduction equipment, the catalyst room which holds a NOx catalyst in the exhaust pipe of an engine is prepared, the reducing agent of NOx is injected by the injection nozzle from the exhaust gas upstream of this NOx catalyst, and the equipment which converts NOx into harmless N₂ according to a catalyst is known. Conventionally, ammonia has been used for this reducing agent.

[0003]

[Problem(s) to be Solved by the Invention] However, ammonia was unsuitable for the NOx reducing agent of the engine both for a problem empty vehicle of the odor when it having been inferior and revealing to mount nature. Moreover, when gas oil was used as a reducing agent, a carbon number could not convert NOx into N₂ efficiently at this point, including the hydrocarbon component of 16 mostly, but gas oil had fault with the high rate of NOx emitted to the atmosphere as it is. The purpose of this invention is to offer the NOx reduction equipment by the catalyst of engine exhaust gas which reforms this and can reduce NOx efficiently, even if the invert ratio of N₂ of NOx is a low hydrocarbon system reducing agent in respect of component composition. Another purpose of this invention is to offer the NOx reduction equipment which can supply the reducing agent of optimum dose according to the operational status of an engine.

[0004]

[Means for Solving the Problem] The composition of this invention for attaining the above-mentioned purpose is explained based on drawing 1 corresponding to an example. this invention is improvement of the NOx reduction equipment by the catalyst of engine exhaust gas equipped with the catalyst room 16 in which it is prepared in the exhaust pipe 12 of an engine 10, and the NOx catalyst 14 is held, and a reducing-agent supply means 20 to be prepared in the exhaust gas upstream of the NOx catalyst 14, and to supply the aforementioned reducing agent to the injection nozzle 18 which can inject a hydrocarbon system reducing agent, and an injection nozzle 18 towards this NOx catalyst 14. The storage tank 22 in which, as for the characteristic composition, the reducing-agent supply means 20 stores the liquefied hydrocarbon 21, The feeding pump 24 which feeds the hydrocarbon 21 stored in this tank 22 through a liquid transfer pipe 23, The reactor 26 which reforms this fed hydrocarbon 21 so that the carbon number may be decreased, It is in having had the hydrocarbon separation room 27 which separates the reformed hydrocarbon and the hydrocarbon which was not reformed, and the compressor 29 which feeds the reformed hydrocarbon to an injection nozzle 18 through the pneumatic tube 28. In addition, the temperature sensor 46 prepared in this NOx reduction equipment at the exhaust gas upstream of the NOx catalyst 14, The load sensor 44 which detects the load of an engine 10, and the rotation sensor 42 which

detects the rotational speed of an engine 10, The 1st flow control valve 31 prepared in the liquid transfer pipe 23, and the 2nd flow control valve 32 prepared in the pneumatic tube 28, It is desirable to have the controller 40 which controls the feeding pump 24, a compressor 29, the 1st, and 2nd flow control valves 31 and 32 based on the detection output of a temperature sensor 46, the load sensor 44, and the rotation sensor 42. Furthermore, it is desirable to form the recovery tank 33 which collects the liquefied hydrocarbons which were not reformed at the pars basilaris ossis occipitalis of the hydrocarbon separation room 27 of this NOx reduction equipment, and to form the recovery pump 36 which returns the liquefied hydrocarbon of this recovery tank 33 to a storage tank 22.

[0005]

[Function] The gas discharged from the engine 10 passes along an exhaust pipe 12, and it flows into the catalyst room 16 with the reducing agent supplied from the injection nozzle 18, and after reduction processing of the NOx in exhaust gas being carried out by the NOx catalyst 14 there and converting into harmless N₂, it is emitted to the atmosphere. Qualitatively, since the reducing agent supplied from an injection nozzle 18 is the hydrocarbon of low molecular weight with which the carbon number by which cracking was carried out by the reactor 26 and refining separation was carried out at the separation room 27 decreased, it converts NOx into N₂ at high efficiency. Moreover, quantitatively, a controller 40 controls a flow control valve 31 and 32 grades, and supplies the reducing agent of the optimum dose corresponding to the NOx content in the exhaust gas memorized according to operational status from an injection nozzle 18.

[0006]

[Example] Next, one example of this invention is explained in detail based on a drawing. As shown in drawing 1, an exhaust pipe 12 is connected to the exhaust manifold 11 of a diesel power plant 10. In the middle of this exhaust pipe 12, an engine side to the reducing-agent injection room 13, the catalyst room 16 in which the NOx catalyst 14 is held, and a muffler 17 are formed in this order. The NOx catalyst 14 is constituted from this example by the copper-ion exchange zeolite (Cu-ZSM -5). This copper-ion exchange zeolite is the matter which transposed the sodium ion which the zeolite contains to the copper ion, and has the property to return NOx with a hydrocarbon. An injection nozzle 18 is formed in the reducing-agent injection room 13 towards the NOx catalyst 14.

[0007] A reducing-agent supply means 20 to supply a hydrocarbon system reducing agent to an injection nozzle 18 The storage tank 22 in which gas oil 21 is stored, and the feeding pump 24 which feeds this gas oil 21 through a liquid transfer pipe 23, It is constituted by the hydrocarbon separation room 27 which separates the reactor 26 reformed so that the carbon number of the fed gas oil may be decreased, and the reformed hydrocarbon and the hydrocarbon which was not reformed, and the compressor 29 which feeds the reformed hydrocarbon to an injection nozzle 18 through the pneumatic tube 28. In this example, a compressor 29 is driven by the motor 30. The 1st flow control valve 31 is formed in the liquid transfer pipe 23 of the discharge side of a pump 24, and the 2nd flow control valve 32 is formed in the pneumatic tube 28 of the discharge side of a compressor 29, respectively. These regulator valves 31 and 32 are solenoid valves, and return-pipe 31a to a tank 22 and return-pipe 32a to the hydrocarbon separation room 27 are connected to regulator valves 31 and 32, respectively.

[0008] A reactor 26 carries out cracking of the gas oil which makes a principal component the hydrocarbon of the carbon number 16 fed from the pump 24, and reforms it mainly for the component of carbon numbers 3-10. A reactor 26 is equipped with column 26a with which the granular zeolite was filled up, and heater 26b which heats this column 26a in this example. The hydrocarbon separation room 27 equips with heater 27b separator 27a divided into the gas oil reformed at carbon numbers 3-10, and the other gas oil, and the circumference. The entrance of column 26a is connected to the aforementioned liquid transfer pipe 23, and the outlet is turned to separator 27a of the hydrocarbon separation room 27. The recovery tank 33 which collects the liquefied hydrocarbons which were not reformed is formed in the pars basilaris ossis occipitalis of this separation room 27, and return-pipe 32a is connected with the pneumatic tube 28 which attracts the hydrocarbon which reformed and was evaporated and which was mentioned above at the crowning of the separation room 27. Between this recovery tank 33 and a storage tank 22, the recovery pipe 34 is connected, and the recovery pump 36 is formed while being the

recovery pipe 34.

[0009] The control output of a controller 40 is connected to the 1st and the 2nd flow control valve 31 and 32, the feeding pump 24, the motor 30 for a compressor drive, Heaters 26a and 27b, and the recovery pump 36. The rotation sensor 42 which detects the rotational speed of an engine 10, the load lever position sensor 44 of the jet pump 43 which detects the load of an engine, and the temperature sensor 46 which detects the exhaust-gas temperature which flows into the NOx catalyst 14 of the catalyst room 16 are connected to the control input of this controller 40. A controller 40 is equipped with the memory which is not illustrated. The amount of the hydrocarbon which should be supplied to the NOx catalyst 14 from an injection nozzle 18 according to the rotational speed, load, and exhaust-gas temperature of an engine is beforehand memorized by this memory, and a controller 40 controls regulator valves 31 and 32, the feeding pump 24, and the motor 30 grade for a compressor drive based on this amount of supply.

[0010] Operation of the NOx reduction equipment of such composition is explained. First, the gas discharged from the engine 10 passes along an exhaust pipe 12, goes into the reducing-agent injection room 13, and receives supply of a hydrocarbon system reducing agent by the injection nozzle 18 here. The exhaust gas which received supply of this reducing agent goes into the catalyst room 16, and after carrying out reduction processing of the NOx in exhaust gas with the NOx catalyst 14 and converting into harmless N₂, it is emitted to the atmosphere. As for the reducing agent injected from an injection nozzle 18 here, the quality is improved by the following method. First, it is sent to column 26a of a reactor 26 with the feeding pump 24 from a storage tank 22, and at the temperature of 400-500 degrees C, gas oil contacts a zeolite catalyst, and decomposes and evaporates. Gas oil is mainly reformed by cracking of this gas oil at the hydrocarbon of the low molecular weight of carbon numbers 3-10. The hydrocarbon of the amount of macromolecules which was not reformed by the reactor 26 is separated with the hydrocarbon reformed by separator 27a of the hydrocarbon separation room 27. This reforming reducing agent by which refining separation was carried out is compressed by the compressor 29, and is injected from an injection nozzle 18. The hydrocarbon system reducing agent with which this carbon number decreased converts NOx into N₂ at high efficiency in the NOx catalyst 14.

[0011] Moreover, the amount of the reducing agent injected from an injection nozzle 18 is controlled by the following method. A controller 40 reads the reducing agent of the optimum dose corresponding to the NOx content in the exhaust gas memorized by memory according to operational status by the detection output of sensors 42, 44, and 46, controls flow control valves 31 and 32, the feeding pump 24, and the motor 30 grade for a compressor drive according to the amount of this reducing agent, and supplies the reducing agent of optimum dose from an injection nozzle 18. Specifically, a controller 40 is controlled so that an engine 10 extracts the injection quantity in a low-speed rotation region at the time of a light load and increases the injection quantity in an inside high-speed rotation region at the time of an inside heavy load. Furthermore, the hydrocarbon system reducing agents of the high-boiling point which was not reformed at the hydrocarbon separation room 27 are collected by the recovery tank 33, and are returned to a storage tank 22 with the recovery pump 36. In addition, although the copper-ion exchange zeolite was mentioned as a NOx catalyst in the above-mentioned example, the catalyst of other zeolite systems and an oxide system is sufficient. Moreover, although the example which cracks gas oil catalytically using a zeolite catalyst in a reactor was shown, you may use other catalysts, such as titanium oxide and a silica alumina catalyst.

[0012]

[Effect of the Invention] In order to reform by the reactor even if it is gas oil which was described above and with which the invert ratio of N₂ of NOx contains the hydrocarbon of a low high-boiling point in respect of component composition of a hydrocarbon system reducing agent according to [like] this invention, to carry out refining separation at a hydrocarbon separation room, to take out an effective hydrocarbon system reducing agent alternatively and to inject from an injection nozzle, on a NOx catalyst, NOx in exhaust gas is efficient and it converts into N₂. Moreover, since the injection quantity of a reducing agent is controlled according to the operational status of an engine and the reducing agent of optimum dose is supplied according to NOx in exhaust gas as a result, NOx contained in exhaust gas

can be reduced effectively.

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PRIOR ART

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The block diagram of the NOx reduction equipment of one example of this invention.

[Description of Notations]

- 10 Engine
- 12 Exhaust Pipe
- 13 Reducing-Agent Injection Room
- 14 NOx Catalyst
- 16 Catalyst Room
- 18 Injection Nozzle
- 20 Reducing-Agent Supply Means
- 21 Gas Oil (Hydrocarbon System Reducing Agent)
- 22 Storage Tank
- 23 Liquid Transfer Pipe
- 24 Feeding Pump
- 26 Reactor
- 27 Hydrocarbon Separation Room
- 28 Pneumatic Tube
- 29 Compressor
- 31 1st Flow Control Valve
- 32 2nd Flow Control Valve
- 33 Recovery Tank
- 36 Recovery Pump
- 40 Controller
- 42 Rotation Sensor
- 44 Load Sensor
- 46 Temperature Sensor

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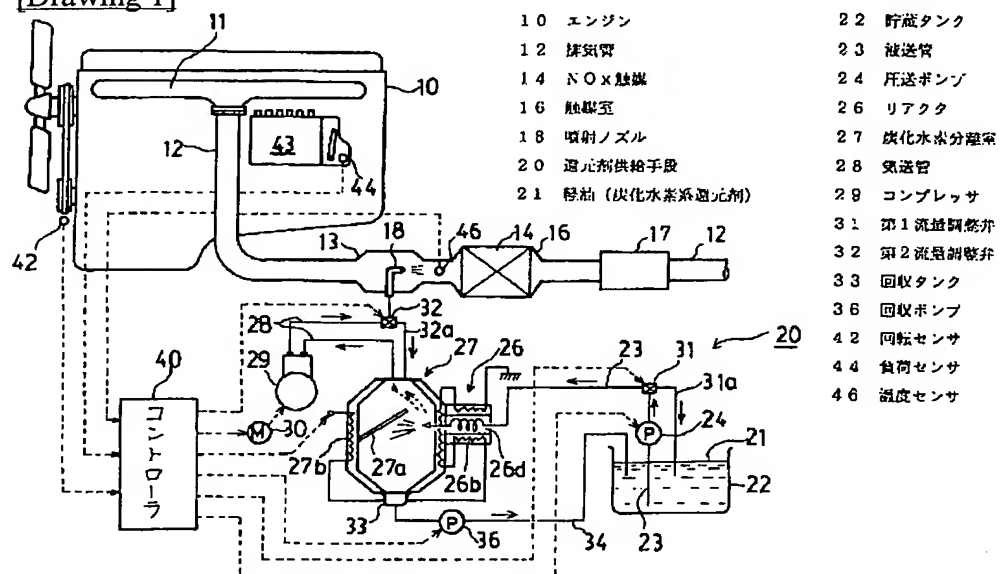
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DRAWINGS

[Drawing 1]



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